

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

1. (Currently amended) Pump device for the hydraulic actuation of a valve for a pipeline or a tree used in the production of crude oil or natural gas, the pump device comprising:

a piston-cylinder unit having a piston within a cylinder, the cylinder having a first port in fluid communication with the valve and a second port, the piston travelling to a first position forcing hydraulic fluid in the cylinder out the first port ~~to the valve~~ under pressure and travelling to a second position drawing hydraulic fluid through the second port and into the cylinder; ~~and~~

an electrical drive movably connected to the piston of the piston-cylinder unit for the alternating movement of the piston in a piston longitudinal direction inside the cylinder;

a discharge pipe coupled between the first port and the valve, the discharge pipe operable to deliver hydraulic fluid from the piston-cylinder unit to the valve for actuating the valve;

a discharge pipe pressure sensor operable to sense a pressure of hydraulic fluid in the discharge pipe and outside the cylinder; and

a branch pipe coupled to the discharge pipe between the first port and the valve, the branch pipe operable to divert hydraulic fluid from the valve when a pressure of hydraulic fluid within the discharge pipe exceeds a predetermined value, whereby the pressure of hydraulic fluid within the discharge pipe is controlled.

2. (Previously presented) Pump device according to claim 1, wherein the electrical drive includes a spindle drive, a reduction gear, a spur gear and at least one drive shaft with at least one electric motor rotating the drive shaft.

3. (Previously presented) Pump device according to claim 2, wherein the spindle drive includes a rotatable, but axially immovable threaded spindle nut threadingly engaging an axially movable threaded spindle.

4. (Previously presented) Pump device according to claim 3, wherein the threaded spindle is a threaded shaft releasably connected at its actuating end to the piston.

5. (Previously presented) Pump device according to claim 3, wherein the spindle nut is movably connected to the reduction gear.
6. (Previously presented) Pump device according to claim 3, wherein the spindle nut is rotationally rigidly connected to a flexible, cup-shaped toothed sleeve of a harmonic drive gear.
7. (Canceled)
8. (Previously presented) Pump device according to claim 6, wherein the spur gear is a helically toothed spur gear having a first spur wheel and a second spur wheel, the second spur wheel being rotationally rigidly arranged on the drive shaft driven by the motor and a wave generator of the harmonic drive gear being rotationally rigidly connected to the first spur wheel.
9. (Previously presented) Pump device according to claim 2, wherein the spur gear is a double helical gear.
10. (Previously presented) Pump device according to claim 1, wherein the piston is adjustably supported in a piston chamber of the cylinder in the piston longitudinal direction, whereby the first and second ports are disposed on a face side of the piston chamber and include at least one suction and one discharge hole, the suction hole opening into an intermediate reservoir of the pump device.
11. (Previously presented) Pump device according to claim 10, wherein a non-return valve is disposed in each hole extending through a valve member and into a cylinder bottom plate, the non-return valves being subjected to a force opposite to the hydraulic fluid flow direction through the respective hole.
12. (Previously presented) Pump device according to claim 10, wherein the holes are formed in a cylinder bottom plate releasably fixed on the cylinder, the cylindrical bottom plate including a branch connected to a pressure switch.

13. (Previously presented) Pump device according to claim 10, wherein the suction hole opens into the intermediate reservoir of the pump device with its end facing away from the piston.

14. (Canceled)

15. (Canceled)

16. (Currently amended) Pump device according to claim 10, wherein the discharge pipe is brought out through ~~the~~an intermediate reservoir from a pump housing.

17.-32. (Canceled)

33. (Currently amended) Pump device according to claim 1, wherein the pump device is of modular construction and includes a ~~pressure-relief-safety~~safety valve communicating with the ~~first inlet~~inlet port.

34. (Canceled)

35. (Previously presented) Pump device according to claim 16, wherein a quick-release coupling device is arranged between the pump housing and a hydraulic fluid supply pipe.

36. (Previously presented) Pump device according to claim 1, wherein at least two servomotors are arranged redundantly with respect to one another.

37. (Previously presented) Pump device according to claim 1, wherein the hydraulic fluid is an injection fluid.

38. (Previously presented) Pump device according to claim 3, wherein a position sensor determines the position of at least the threaded spindle.

39. (Previously presented) Pump device according to claim 5, wherein the reduction gear is a harmonic drive gear.

40.-41. (Canceled)

42. (Previously presented) Pump device according to claim 37, wherein the injection fluid is an inhibitor.

43. (Currently amended) Pump device for the hydraulic actuation of a safety valve on a pipeline or tree used in the production of hydrocarbons, the pump device comprising:

a body with a cylinder housing a piston such that hydraulic fluid can be pumped under pressure therefrom to the safety valve;

a discharge pipe receiving hydraulic fluid under pressure from the cylinder and delivering the hydraulic fluid to the safety valve;

a sensor for sensing the hydraulic fluid pressure in the discharge pipe and outside of the cylinder;

a pressure switch receiving signals from the sensor;

an electrical drive device movably connected to the piston of the piston-cylinder unit to move the piston in a longitudinal direction inside the cylinder upon the hydrocarbons reaching a predetermined pressure in the pipeline or tree; and

the pressure switch activating a relief valve to relieve the pressure from the safety valve in the cylinder upon the pressure in the discharge pipe reaching a predetermined value in the cylinder measured by the sensor.

44. (Currently amended) An apparatus for supplying pressurized hydraulic fluid to actuate a valve on a subsea tree used in the production of hydrocarbons, the apparatus comprising:

a piston-cylinder unit having a piston within a cylinder to force hydraulic fluid from the cylinder under pressure ~~through a conduit to the subsea tree valve for hydraulic actuation of the subsea tree valve; and~~

an electrical drive movably connected to the piston to drive the piston within the cylinder to pressurize the hydraulic fluid;

a discharge pipe coupled between the piston-cylinder unit and the subsea tree valve, the discharge pipe adapted to receive hydraulic fluid from the piston-cylinder unit and deliver hydraulic fluid to the subsea tree valve, whereby the subsea tree valve is hydraulically actuated;

a branch pipe coupled to the discharge pipe between the piston-cylinder unit and the subsea tree valve;

a safety valve coupled to the branch pipe, the safety valve actuatable to receive hydraulic fluid from the branch pipe, whereby hydraulic fluid is diverted from the subsea tree valve; and

a pressure switch operable to actuate the safety valve when a pressure of hydraulic fluid in the discharge pipe exceeds a predetermined value.

45. (Previously presented) The apparatus of claim 44 further including a hydraulic source located subsea and the cylinder of the piston-cylinder unit communicating with the hydraulic source to pump the hydraulic fluid.

46. (Previously presented) The pump apparatus of claim 44 wherein the piston-cylinder unit and electrical drive device are adapted for releasable connection to the body of the subsea tree.

47. (Currently amended) A pump device for the hydraulic actuation of a safety valve on a pipeline or tree used in the production of hydrocarbons, the pump device comprising:

a body with a cylinder housing a piston such that hydraulic fluid can be pumped under pressure from the cylinder to the safety valve; ~~and~~

an electrical drive device movably connected to gears for rotating an axially immovable threaded spindle nut threadingly engaging an axially movable threaded spindle connected to the piston of the piston-cylinder unit to move the piston in a longitudinal direction inside the cylinder as the threaded spindle nut threads onto the threaded spindle;

a discharge pipe coupled to the cylinder, the discharge pipe receiving hydraulic fluid under pressure from the cylinder and delivering the hydraulic fluid to the safety valve to actuate the safety valve;

a sensor sensing a pressure of the hydraulic fluid in the discharge pipe and outside of the cylinder; and

Appl. No. 10/564,584
Amdt. Dated February 23, 2010
Reply to Office Action of January 26, 2010

a pressure switch receiving a signal from the sensor and operable to divert hydraulic fluid from the safety valve when the pressure of the hydraulic fluid exceeds a predetermined value.